SCIENCE

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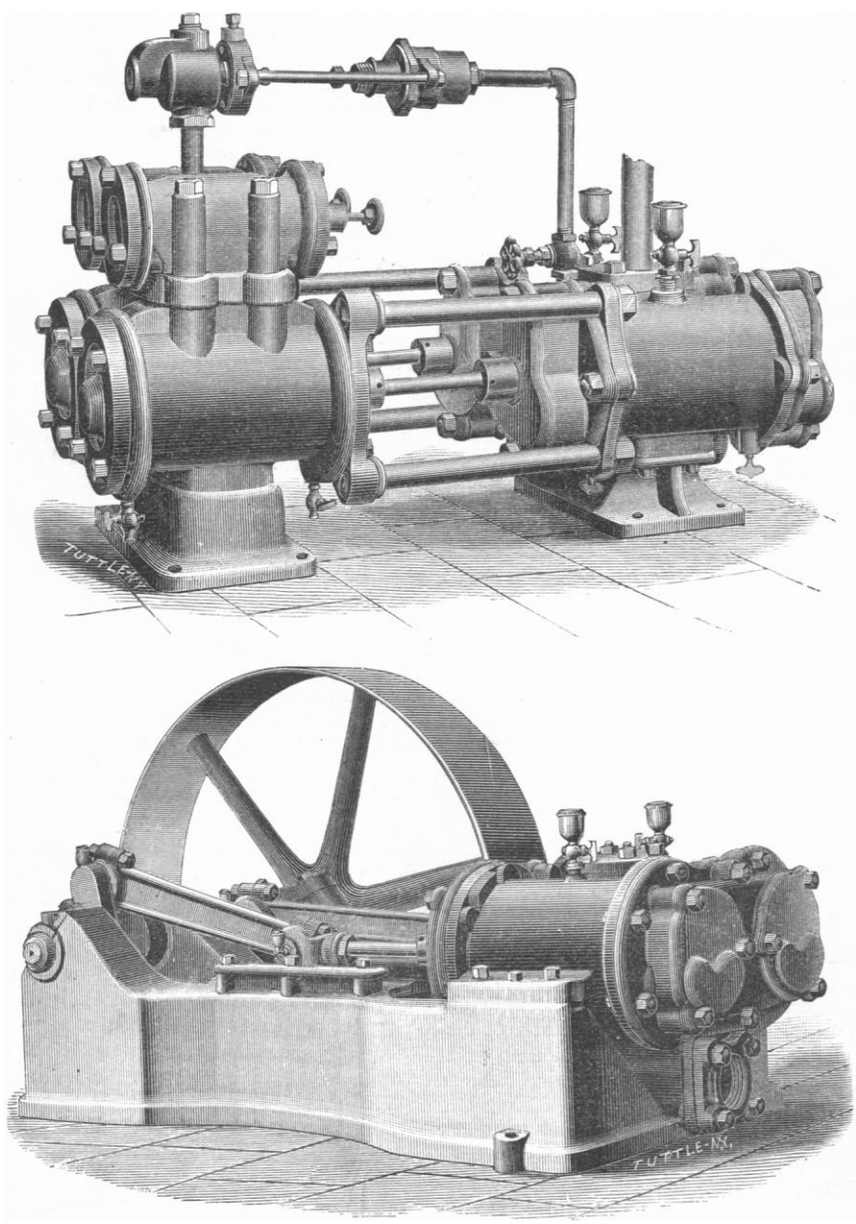
THE HALL AIR-COMPRESSOR.

FOR any purpose in which a positive air-pressure is required, a compressor possesses many advantages over a fan or blower. Even for moving air for ventilating purposes, where under ordinary circumstances a blower answers very well, there are times and places in which a positive movement of the air, such as that produced by a compressor, is not only desirable, but actually necessary. For such purposes, where the required pressure does not exceed twenty-five pounds to the square inch, the compressors shown on this page are intended.

These compressors are built by the Hall Steam Pump Company of this city, and they are much used for elevating liquids, such as strong acids, etc., as well as for ventilating mines and shafts. They are also largely used for furnishing the air-blast where oil, atomized or converted into spray, is made use of on a large scale for fuel. Such a system of burning atomized or aerated petroleum was described and illustrated in *Science* of April 5, 1889.



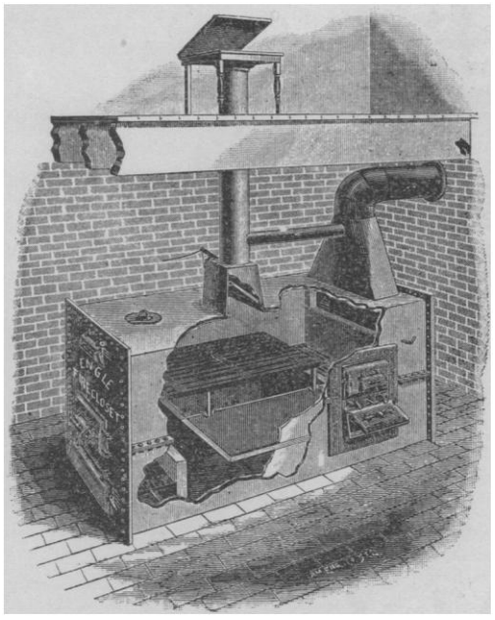
THE HALL AIR-COMPRESSOR.

Both the compressors shown here are duplex or double-acting, but they differ in other features. One is actuated by steam direct, and the other is intended to be driven by a belt. The valves and much of the other mechanism of the compressors are constructed on the same principles as those of the steam-pumps made by the same company, which are too well known to require any description here. As the length of stroke of the pistons, in both the pumps and the compressors, is about the same under all ordinary variations of steam-pressure or load, much less clearance is needed for the steam-valves than would otherwise be necessary, — an important point in the construction of compressors. Any desired air-pressure may be maintained by means of an automatic regulator, which opens or closes a valve in the steam-pipe. It may be added that these machines are as compact and simple in construction as is compatible with the uses for which they are intended; and they are not liable to get out of order, even when run at high speeds.

GARBAGE CREMATION.

We had occasion a year ago to describe the Engle furnace for the cremation on a large scale of a city's garbage. To-day we are able to show an illustration of a small furnace for the same use in private houses.

It is doubtless true that nature has its own way of transforming offensive unsanitary matter into new forms in which it is no longer dangerous; but the application of fire can bring about in a few



THE ENGLE FIRE-CLOSET.

moments that which, if left to natural processes, would take weeks or months to accomplish.

The practice of cremation in place of burial is doubtless growing, and is each day gaining new adherents. A recent canvass of the opinions of the leading physicians of Philadelphia brought out the fact that the majority of them favored the fire method of disposal of human bodies, several of them taking occasion to point out that it all comes to the same thing in the end, the difference being only in the time consumed.

The Engle fire-closet is the application, on a somewhat smaller scale, of exactly the same principles contained in the garbage cremator described last year. By the use of two fires, one at either end of a small furnace, the smoke and gas evolved in consumption are destroyed, There is no escape of any offensive smell, and the furnace perfectly supplies the use intended, for the sanitary and economical destruction of all matters placed therein.

The advantages of such an apparatus as this are obvious. It is placed in a dwelling, where it is used for the reception and destruction of all garbage, as well as night-soil. It is especially useful in places of public resort, hotels, and restaurants, where a large number of people congregate, and supplies the place in such institutions of an expensive and elaborate system and sewerage. It is in daily use in large collegiate institutions and public-school buildings of cities where no adequate system of drainage is in force, and is serviceable for the destruction of the waste and worthless matters produced by all manufacturing establishments.

The Engle fire-closet is in use in hospitals, for the burning of infected clothing, bedding, furniture, and other matter requiring to be destroyed, from patients suffering with contagious or infectious diseases. As an adjunct to the disinfecting and quarantine stations of cities and the general government, it is an auxiliary of importance.

The illustration shows the construction of an Engle fire-closet adapted for the use of a single family. The matter to be destroyed, both solid and liquid, is received directly through soil-pipes from closets above into the evaporating pans and on the garbage bars of the furnace. The flues into the chimney are kept open, and there is no escape of any smell or odor into the surrounding room; and at the proper time fire is applied, and the contents are destroyed. These fire-closets are constructed of steel, lined with fire tiles, with receiving pans adapted for the purpose required, and occupying a comparatively limited space. They are placed in convenient locations, usually in the lower part of the building, or in the cellar, where access can be had to a flue or chimney of moderate size. Being portable and easy to handle, they may be removed at any time to any other desirable site as the exigencies of the weather may require.

A NEW PROCESS OF PROTECTING IRON EFFECTUALLY AGAINST CORROSION.

The following report on this process was made by Professor H. Haupt to the Franklin Institute of Philadelphia some time since: —

"For a period of more than ten years experiments have been made under the auspices of the Hydrogen Company of the United States to discover a simple, economical, and practical method of protecting iron and steel from all ordinary corrosive influences. A large number of patents were secured, and about $100,000 expended in the erection of plants at Washington, D.C., Newburg on the Hudson, and New York; and some of the results were of the most satisfactory character. Iron that had been treated by the processes referred to effectually resisted the action of nitro-muriatic acid and other severe tests to which it was subjected, while untreated iron was immediately attacked by the acids and quickly destroyed.

"But, although many of the specimens thus treated gave very satisfactory results, others proved defective; and it became apparent to the contributors to the funds that the exact conditions as regards temperature, quality, and quantity of material employed, and duration of treatment, had not been so accurately determined that results could be duplicated with unerring certainty, — an essential condition, without which no process could ever be made a commercial success.

"This explanation has been considered necessary to account for the fact that an industry which promised results of such extraordinary value to the public and to the parties financially interested should have been allowed to linger until the greater portion of the life of the original patents had expired.

"But persistency has at last been rewarded with success. The company succeeded in securing the services of a thoroughly practical and scientific engineer, chemist, and metallurgist, Dr. George W. Gesner, who was enabled to discern the defects of former treatments, and to remedy them successfully by new apparatus and processes, which have recently been patented; so that, while the old patents are still held by the company, they have to a great extent been superseded by more recent issues, under which operations now are and will hereafter be conducted.

"The former treatment consisted in placing the articles to be operated upon in a close chamber, similar to a gas-retort; and when heated to a temperature of about 1200° F., steam superheated in a separate furnace was introduced, followed by naphtha or other hydrocarbon vapor.

"The results, as previously stated, were not always uniform, and,

when satisfactory, could not be duplicated under former management with certainty as to the result.

"All this is now changed; and the results are so uniform and certain, that, with a few hours of instruction in the manipulation of the apparatus, an ordinary laborer, with no technical education and with average intelligence, can secure results with entire uniformity.

"Dr. Gesner soon discerned that one of the chief defects in the former treatment arose from the fact that the steam superheated in a separate furnace, and conducted by pipes into the retort, was invariably cooled to the extent of several hundred degrees before admission, and came in contact with the heated iron at a much lower temperature.

"To remedy this defect and insure absolute uniformity of temperature between the iron and the superheated steam at the instant of contact, a peculiar but very simple form of superheater was devised, and inserted in the retort itself. The result was entirely satisfactory; and, after a number of experiments by him to determine the conditions necessary to insure the best treatment, the works were turned over to an employee, who has since operated them with uniform results.

"The plant now in operation is located at East Port Chester, near the extensive foundery of Abendroth Brothers, and consists of twelve vertical retorts with a capacity for the treatment of about twenty tons per day of the Gesner sanitary soil-pipe. The time required for each charge is about two hours.

"After the pipes have been lowered into the retorts by means of a traveller, the retorts are closed for about fifteen minutes, until the contents are heated to the proper temperature. Steam from a boiler at sixty pounds pressure is then introduced into the superheater, which it traverses, and from which it escapes at the temperature of the iron, upon which it acts for about one hour. A measured quantity of some hydrocarbon is then admitted with a jet of steam, followed again by a fixing-bath of superheated steam, which completes the process.

"The most extraordinary feature of the operation is that, as Professor Gesner positively asserts, there is no pressure in the retort, and no free explosive gases. The water-seals attached to the retorts show only slight oscillations, but not an inch of pressure; and when the covers are removed, and air admitted, there is no explosion, as there always is when free hydrogen or carbonic oxide are present, and as there always was before Professor Gesner took charge.

"The absence of pressure and of explosive gases is a proof that all the operations have been so nicely regulated as regards material used, quantity, and time of application, that a perfect absorption and union of the carbon, oxygen, and hydrogen with the iron has been effected.

"The protection thus afforded to the iron is not a mere coating, like paint, but an actual conversion, to a greater or less depth, into a new material, just as, in the process of case-hardening, iron is converted into steel. When properly treated, this material does not seem to be detachable by pounding, bending, hammering, rolling, or heating. The pipes treated at Port Chester have been immersed in baths of dilute sulphuric acid, and exposed to the salt air for weeks without change, while untreated pipes were quickly covered with red oxide or with sulphate of iron.

"The exact chemical composition of the material produced by this treatment has not been reported upon by Professor Gesner, but it is probably a carbide, hydride, and superoxide of iron. This would seem to be a necessary result, if, as is stated, the retorts when opened contained no free gases, neither hydrogen, oxygen, nor carbonic oxide. As these gases are necessarily formed, their disappearance can only be explained on the theory that they have combined with the iron, forming the three compounds of superoxide, plumbago, and the alloy of hydrogen and iron, for which Professor Gesner has proposed the name of 'hydron.'

"The plant now in operation at Port Chester has been designed simply for cast-iron soil-pipe, but Professor Gesner is preparing plans for a more extensive plant for the treatment of wrought iron and steel, to be erected at South Brooklyn.

"In the application of this process, each specialty will require a plant adapted to it, and a series of experiments to determine the exact conditions as to temperature, quantity, kind, duration, etc., to secure the best results, after which they can be duplicated indefinitely with any ordinary intelligence.

"The question is often asked, 'What is the effect of this treatment upon the tensile strength of the material?' This can only be answered by direct tests; but if the new material should not possess the tensile strength of the untreated iron, as in wires or rods, compensation can be secured by a slight increase in diameter. It is certain that in some specimens the treatment has increased the toughness and strength by the annealing process to which the material is subjected. Sheet iron of poor quality, that would break by bending, has been rendered tough and pliable.

"The cost of the process is said to be about one-fourth of that of galvanizing, while the durability under similar conditions promises to be greatly extended."

SUPPOSED SHOWERS OF METEORITES IN THE DESERT OF ATACAMA.

IT is now universally acknowledged, says a correspondent of *Nature*, that meteorites come from outer space, and that shooting-stars, whatever they are, have an extra-terrestrial origin. It is further asserted that a meteoritic fireball and a shooting-star are only varieties of one phenomenon. Indeed, after it is once granted that a meteoritic fireball is produced by the passage through the terrestrial atmosphere of a dense body entering it with planetary velocity from without, and that shooting-stars have an extra-terrestrial origin, it is a very fair assumption that a shooting-star is likewise a dense body rendered luminous during its atmospheric flight.

One great objection to this assertion is, that again and again showers of hundreds of thousands of shooting-stars have taken place, during which no heavy body has been observed to reach the earth's surface. The only known case of the arrival of a meteorite during a shooting-star shower was that of Mazapil, on Nov. 27, 1885, and that single coincidence may possibly be the result of accident. A sufficient explanation of this difficulty, however, is to be found in the small size of the individuals which produce the appearance of a shooting-star shower. That the individuals are really minute is proved by the fact, that, while the total mass of a large swarm, like that producing the November meteors, is so small that there is no perceptible influence on the motion of the planets, the number of separate individuals is almost infinite. It is established that the Leonid swarm must be hundreds of millions of miles in length, and some hundreds of thousands of miles in thickness; and in the densest part of the Bielid swarm, passed through in 1885, the average distance of the individuals from each other was about twenty miles.

Further, it is now acknowledged that comets are themselves meteoritic swarms, and Mr. Lockyer has lately brought forward spectroscopic evidence that the fixed stars and the nebulæ are similar to comets in their constitution.

The question therefore immediately presents itself, is the size of a meteoritic shower, on reaching the earth's surface, ever comparable with that of a meteoritic swarm, as manifested by a shower of shooting-stars?

During the present century nearly three hundred meteoritic falls on the earth's surface have been observed, and on only a single date, namely, Aug. 25, 1865, has there been observed a fall on two distant parts of the earth on the same day. On that date stones fell at Aumale in Algeria, and at Sherghotty in India; but as the times of fall differed by about eight hours, and the stones arrived from different directions, it is more than probable that the coincidence of date was accidental.

The most convincing proof of the actuality of such showers is furnished by the masses which have been found in the valley of Toluca, in Mexico. Their existence had been chronicled as early as the year 1784, yet in 1856 it was still possible to collect as many as sixty-nine. Belonging, as they do, to a single type, they lead to the conviction that they are the result of a single shower. But the region over which the fall took place is not large: the length of it is said to have been only about fourteen miles.

It is a question of a certain amount of interest as to whether there is any evidence of the actual fall of a shower of meteorites over a large extent of the earth's surface. Such evidence has long been supposed to be furnished by the plentiful occurrence of meteorites in the Desert of Atacama, a term applied to that part of western South America which lies between the towns of Copiapo and Cobija, about 330 miles distant from each other, and which extends inland as far as the Indian hamlet of Antofagasta, about 180 miles from the coast.

The generally received impression as to the occurrence of meteorites in this desert is well illustrated by the following statement of M. Darlu of Valparaiso, read to the French Academy of Sciences in 1845:—

"For the last two years I have made observations of shooting-stars during the nights of Nov. 11–15, without remarking a greater number than at other times. I was led to make these observations by the fact that in the Desert of Atacama, which begins at Copiapo, meteorites are met with at every step. I have heard, also, from one who is worthy of trust, that in the Argentine Republic, near Santiago del Estero, there is, so to say, a forest of enormous meteorites, the iron of which is employed by the inhabitants."

A study of the literature indicates that "the forest of enormous meteorites" near Santiago del Estero, understood by Darlu as significative of infinity of number, is really a free translation of a native statement "that there were several masses having the shape of huge trunks with deep roots," and that not more than four, or perhaps five, masses had really been seen in the Santiago locality at the time of Darlu's statement. There is a similar misunderstanding relative to the Atacama masses: it is clearly proved, that, at a date long subsequent to 1845, the desert was virtually untrodden and unexplored. In Darlu's time it was only crossed along definite tracks by Indians travelling between San Pedro de Atacama and Copiapo, and between the inland Antofagasta and the coast. In fact, it is established that the only Atacama meteorites then in circulation were all got from a single small area, three or four leagues in length, in the neighborhood of Imilac, one of the few watering-places on the track between San Pedro and Copiapo.

Since that time the discovery of rich silver-mines in the centre of the desert, and the working of the nitrate deposits, have led to vast changes; the desert has been more or less closely examined, and other meteoritic masses have been found. Still, the number of meteorites yet discovered, distinct either in mineralogical characters or locality, is shown to be, at most, thirteen.

One of them, Lutschaunig, is distinct from all the rest as being a chondritic stone; a second, Vaca Muerta, likewise differs from all the others in that it consists of nickel-iron and stony matter, both in large proportion; a third, Imilac, is a nickel-iron with cavities, like those of a sponge, filled with olivine; a fourth, Copiapo, is a nickel-iron with irregularly disposed angular enclosures of troilite and stony matter; the remaining nine consist of nickel-iron, virtually free from silicates, some of them showing no Widmanstätten figures when etched, others showing excellent figures more or less differing in character.

Now, in every meteoritic shower yet observed, the individuals which have fallen simultaneously have been found to belong to a common type. Hence it is reasonably certain that several distinct meteors are represented in the desert, and that the above masses are the result of several falls; and, this being accepted, the assertion of simultaneity of fall of two or more masses on the purely geographical ground that they have been found in the same desert, can be allowed no great weight.

It is thus clear that the meteorites of the Desert of Atacama afford absolutely no proof that enormous meteoritic showers have ever reached the earth's surface.

The general dryness of the air of the desert, and the rarity of rain, have been sufficient to insure the preservation of masses which have fallen in the course of many centuries unto a time when an exploration of a large extent of the desert has taken place.

That the meteoritic masses are far from being so plentiful as has been imagined is conclusively proved by the experience of Mr. George Hicks, one of the earliest explorers of the 23d and 24th parallels. Although much interested in their occurrence, he never found a mass himself, and he only obtained his first specimen after years of persevering inquiry from the Indians.

THE PULSION TELEPHONE.

A CURIOUS scene was enacted recently at a place called Child's Hill, on the Midland Railway, near London, England. What took place there, as vouched for by *Engineering*, was as follows. A party of gentlemen alighted from the train and ascended the embankment. Here one of them reached up to a wire stretched along the telegraph poles, and, placing the crown of his hat flat against it, he commenced a conversation with some unseen correspondent. The answers to his questions and remarks came back quite audibly to the group gathered around him, while those who felt sceptical as to the reality of what was being enacted before them, removed to a distance, and, pressing the wire against their ears and cheek-bones, heard the return messages for themselves. After some desultory conversation, the unknown speaker was asked to give a good shout, and in reply he jodelled with such vigor that a boy plodding his way along the cutting, at the opposite side of both up and down lines, looked up with amazement. He was at least eighty or one hundred feet distant, and yet he evidently heard the yell transmitted along the wire and received into the crown of an ordinary silk hat. It was quite impossible that he should have caught the original sound, for it was uttered in a cabin built on the side of the line at the Welsh Harp station, more than a mile away, and probably was not directly audible for one hundred yards. Those who were on the embankment knew that it was transmitted by means of a new mechanical telephone, for they had already listened to the same voice at Finchley-road station, which is $3\frac{1}{2}$ miles from the Welsh Harp.

When every one had satisfied himself that spoken words, whistling, and musical sounds could be received without special apparatus, the party re-entered the train, and went on to the Welsh Harp station, where they found several lines erected in the grounds of the local hotel. One of the lines starts from a small cabin in the grounds; it then proceeds to a post on the margin of the lake, and goes right across to a hut on the opposite bank. The distance is between a fourth and a third of a mile; and as this wire is not particularly tight, and only starts at a height of about ten feet above the water, it will be readily understood that it must lie for nearly its entire length in the mud which forms the bed of the lake. Another line traverses the gardens; its supports are formed by branches of trees, around several of which it is wound three times, and is then led off at an angle to its original direction. In another instance a row of statues are made to carry a line, which is laid upon any part of them which furnishes a convenient guide. This line is so slack that it can be bent into S form by the thumb and forefinger. The very various circumstances appeared, however, to make but little difference to the instruments, and in all cases conversation could be carried on with the greatest ease, and often could be heard a foot or two away from the receiver.

The instrument by which these curiously constructed lines were made to give such remarkable results is the property of the British Pulsion Telephone Company. It is the invention of Mr. Lemuel Mellett of Newton, Mass., and already several hundred instruments are at work in Boston and elsewhere. The construction is so exceedingly simple, that one is filled with wonder that it can effect so much. The receiver, which also acts as a transmitter, consists of a wooden case, divided into two parts by a metallic diaphragm held by a clip-ring and screws. In the centre of the diaphragm is a hole through which there passes the line wire, having at its end a button to take the pull. So far there is no special novelty to distinguish the telephone from the old pill-box and string. The new feature consists in a set of resonators placed over the diaphragm to re-enforce its vibrations. These resonators may be made in many different forms; those used on this occasion are spiral springs of various lengths, and made from wire of different gauges. One set of springs is festooned between the screws which hold the diaphragm, while others are held at one end only, and project upwards and inwards within the case. These resonators are chosen experimentally of such dimensions that each will be set into vibration by some one or more of the tones which are usually

found in the human voice. Consequently the faintest vocal tremor imparted to the disk is immediately taken up by them, and immensely magnified. This is done both at the transmitting and receiving ends, the result being that the wire is put into intense molecular vibration of a hitherto unappreciated character. It is evidently not merely lateral vibration, like that of a guitar string, for such motion would certainly be damped in the wire laid in the lake; it would also greatly suffer in the case of a span strung so slackly that at the centre it rests for many feet on the ground, yet such a span was shown to work reasonably well. It is evident, however, that the vibration is not purely longitudinal, for if it were it should be transmitted through a coil of wire flung loosely on the ground; and this, we understand, is not the case. It would, however, be a waste of time to try and formulate a theory apart from experimental investigation. What principally concerns us now is the fact that a mechanical telephone has been constructed, which will speak with absolute distinctness for three and a half miles, and which is simple, cheap, and, most important of all, free from induction. It is easily conceivable that its performances may be much improved; new forms of resonators may be found that have a nearer affinity to the tones of the voice than those already tried. Two vocal chords form the source of all the sounds we can utter, even if we be as gifted as Patti, and it seems possible that some material may be found more nearly allied to their action than wire helices. Although these can vibrate in harmony with the tones of human language, they have not the same quality of sound, and the metallic resonance which they impart to the articulation they transmit is not altogether an improvement.

HEALTH MATTERS.

Preventive Inoculation for Yellow-Fever.

WE are indebted to the *Medical Record* for the following translation of a report which was presented to the Academy of Sciences, Paris, by Dr. Domingos Freire, professor of organic chemistry and biology in the faculty of medicine of Rio de Janeiro, Brazil.

The epidemic of yellow-fever that developed in Rio de Janeiro in 1888 and 1889, and which propagated itself in several other places in the interior of Brazil, has been the means of demonstrating for the fourth time the value of inoculations by means of the attenuated microbe of yellow-fever. The maximum of the epidemic was between the months of December and March, the first sporadic cases having appeared about the end of the month of May, 1888, and the last in June, 1889. During this period there were inoculated 3,570 people; to wit, 988 strangers and 2,582 Brazilians, divided thus: the city of Rio, 2,138; city of Campinas, 651; town of Vassouras, 199; city of Nicteroy, 166; city of Santos, 133; Desengano, a village of 425 inhabitants, 102; Serraria, a small town, 80; city of Rezende, 54; Cataguazes, a village of 2,000 inhabitants, 50. The disease swept with great intensity in all of these spots, and the vaccinations were made, for the most part, during the height of the epidemic.

Of the 2,582 Brazilians, there were 1,740 that should be added to the 988 strangers, as this figure embraces not only individuals coming from the interior and resident in the city of Rio for less than six years,— that is to say, non-acclimated,— but also children, who, according to our experience, are just as susceptible as the strangers themselves.

The rate per hundred of mortality among the vaccinated was 0.078: at Santos, at Rezende, at Serraria, and at Cataguazes, the immunity from the disease was absolute. Here is the rate per cent from each locality: Rio, 0.98; Campinas, 0.46; Vassouras, 0.05; Nicteroy, 0.75; Santos, 0.00; Desengano, 0.09; Serraria, 0.00; Rezende, 0.00; Cataguazes, 0.00. The mortality from yellow-fever among the non-vaccinated was 4,135, divided thus: city of Rio de Janeiro, 2,407 (this includes the dead from the Marine Hospital); Campinas, 812; Vassouras, 15; Nicteroy, 177; Santos, 650; Desengano, 221; Serraria, 21; Rezende, 11; Cataguazes, 20. Among the 4,135 there were about 2,800 strangers, of whom, 1,176 died in Rio (and 750 of these in the Marine Hospital), 63 at Nicteroy, 500 (about) at Santos, 300 (about) at Campinas, 7 at Desengano, 3 at Rezende, 3 at Vassouras.

Thus one-fourth of the deaths were among Brazilians who were unaccustomed to the poison, inasmuch as they resided in localities where the epidemic appeared for the first time this year. In order to make the efficacy of the inoculations more marked, it suffices to remember the proportion established by M. Jemble in Senegal; namely, that among the strangers who had been there from one to three years, 75 per 100 were attacked by yellow-fever, and 68.06 per hundred died.

Applying these facts to the vaccinated strangers, or the provincials who had from a few days' to three years' residence in the infected locality, the following results were obtained. At Rio were vaccinated 1,183 people under the above conditions, of whom at least 591 should have succumbed to the disease, but only 18 died. Thus 573 lives were saved. At Campinas, a city that never before had an epidemic of yellow-fever, and where the 651 inoculated might be considered as new arrivals, of whom 325 should have died, the unsuccessful inoculations were but 3. At Vassouras, 5 should have died; one only died, who was not a recent arrival. At Nicteroy the 11 strangers, under the conditions cited above, should have furnished five deaths; one only was a victim. At Santos, of 57 persons under the same conditions, 28 should have died, but the immunity from disease was absolute. At Desengano, the two unsuccessful inoculations were among strangers who had lived from six to eight years in the country. But in view of the fact that the disease obtained for the first time, all of the 102 persons inoculated were as susceptible as strangers who had just arrived. Among them 51 should have died. At Serraria, according to the main calculation, 39 should have died, whereas the immunity from the disease was absolute. The same reflections apply to Rezende, where the 54 vaccinated should have furnished 27 deaths, and at Cataguazes, where the 50 vaccinated should have furnished 25 deaths, in view of the fact that the epidemic made its first appearance in these two localities; still the immunity was perfect, without exception.

There were vaccinated, between 1883 and 1889, 10,524 people, with a mortality of 0.04 per hundred.

Vaccinations made in 1883-84	418
" " 1884-85	3,051
" " 1885-86	3,473
" " 1888-89	3,582
	10,524

Dr. Freire ceased vaccinating in 1887, owing to his trip to Europe and in the United States. The mortality from yellow-fever among the non-vaccinated, during the four epidemics mentioned above, was close on to seven thousand. It may be added, in closing, that all the results given have been authenticated by a large number of medical men, and municipal and police authorities. The vaccinations were made without fee. This succinct statement proves, without question, the truth of all the doctrines founded by the eminent master, M. Pasteur.

ANTIPYRINE HABIT. — To the already long list of drugs the use of which, under proper restrictions, is both beneficial and proper in combating the various ills to which flesh is heir, but whose abuse becomes a curse to humanity, another has recently been added. Scarcely have we learned to properly use antipyrine, says the *International Dental Journal*, than the tocsin of alarm must be sounded against its abuse. The recent discovery of its value as a nerve-tonic places it on the list with morphine, chloral, cocaine, etc., so seductive is its gentle, soothing influence upon the overstrained nerves. Its victims are already found, especially among society women, whose nerves, strung up to a high pitch by the overwhelming demands of a winter season of gayety, seize eagerly upon any thing that will afford relief from the headaches and other disorders arising from prolonged fatigue and overtired nerves. So pleasing is the effect, that it is soon used for every trifling ill feeling, until the patient finds herself unable to live without it, and the fascinating "antipyrine habit" is formed. Properly used as a nerve-tonic, its effects are admirable, but abused, the victim becomes even more hopelessly entangled than the morphine or cocaine victim. The effects vary with the dose. In large doses it produces complete relaxation with loss of reflex action. In moderate doses, continued, it induces convulsions. As a stimulant its effect is much like that of quinine.

Hygiene and Sunday.

Among the questions treated of at the recent congresses in Paris, says the London *Lancet*, that of the observance of the sabbath as a day of rest was not the least interesting. The congress on this subject was presided over by M. Léon Say, who remarked that this rest, which several religions rendered obligatory, is a law of nature, and consequently a law of hygiene, the excellence of which has long been demonstrated, although it is not to be found in all national codes. The resting on the seventh day is of biblical origin, and the custom of counting the days by seven was formerly the rule among the most diverse races, — in India, as among the Celts, in China as well as in Arabia. Now that hygiene has become a positive science, it confirms the moral and material necessity for a temporary rest on the seventh day.

Several reports were presented to the congress, and physicians, professors, philosophers, and hygienists are in accord on this point. All, without exception, support for workers of all classes and of all ages a weekly day of rest, which should even be made obligatory. It may here be noted that in 1881 this subject was opened to competition by the Swiss Government for a prize, which was awarded to Dr. Niemeyer of Leipzig. The subject was brilliantly treated by Dr. Niemeyer, who observed that the dominical rest is the first commandment of hygiene, which should be followed to obtain a peaceful and continued amelioration of society, and in this respect it is as much a rational institution as a religious one.

The following is the summary of the conclusions as voted by the great majority of the members of the congress: "Rest on Sunday is possible in varying degrees in all industries. Sunday is the day which best suits the employer and employed, both as regards the individual himself and his family, and it is well that the day of rest should be as much as possible the same for all. When the Sunday rest is impracticable for certain reasons, it should be replaced by some other day, so that the workman may have fifty-two days' rest in the year as equally divided as possible. This rest permits man to produce considerably more and better work, inasmuch as it contributes to maintain his zeal and to restore his physical forces."

ITALIAN SAUSAGES. — The excitement caused throughout Italy by the detection of extensive frauds in the Bologna-sausage manufacture is spreading. Other cities, notably Florence, are demanding an immediate inspection of the same articles of food as are vended in Italian warehouses. The public, says the *Nazione* of that city, are entitled to some such inquiry in their behalf as has just yielded such startling results in Bologna. Instead of the pig's flesh, popularly supposed to form the main ingredient in the Italian sausage, horse-flesh is that which is really used, — horse-flesh moreover, of more than dubious origin, taken from animals that have died of infectious disease, and even that in an advanced state of decomposition. According to the *Tribuna*, there has been collusion between certain sausage-manufacturing firms and the veterinary authority, the latter winking at frauds which it ought to have exposed. The new powers conferred by the Codice Sanitario, indeed, are finding material for their exercise in quarters hitherto above suspicion; in an industry, to wit, which has long been one of the special boasts of Italy.

NOTES AND NEWS.

THE municipality of Paris is considering the feasibility and expediency of increasing the water-supply for that city by impounding the head waters of the Vigne and Verneuil. This would admit of increasing the water-supply to fifty-five gallons per head per day, the present supply being only twenty-two gallons per head per day, besides giving a much purer water for domestic uses.

— It may prove of interest briefly to describe a series of models that have recently been loaned to the Johns Hopkins University by E. H. Butler & Co. of Philadelphia. The set includes North America, South America, Europe, Asia, Africa, the United States, and Pennsylvania. The models are the work of the Mindeleff Brothers of the United States Geological Survey, who prepared them expressly for the publishers. They have been used in illustrating the geographies recently published by that firm. The models surpass in elaborateness any that have hitherto been constructed, and, by agreement with the publishers, they remain the only set, as no copies will be made of the present series. They are made of plaster-of-Paris, and the approximate dimensions are four feet by three feet and six inches. The land is represented in buff on a blue ground, thus assuring a sharp outline to each continent and its accompanying islands. The mountainous portions stand out in bold relief, so that the chief elevations and depressions of the continents are clearly emphasized. The prominent river courses, with their characteristic channels of broad valley or narrow cañon, are plainly shown. One of the most striking features in the topography is the distinctness with which the chief drainage basins are outlined. The extent of the Mississippi basin, for example, and the character of its topography are at once apparent. On the enlarged relief of the United States more details are added than were possible on the model of North America, while on that of Pennsylvania the characteristic features of Appalachian topography are plainly exhibited. The great importance of such models for purposes of illustration in physical geography cannot be over-estimated. The value of the entire set is not far from $2,000. Mr. J. A. Shriver placed the sum of $175 at the disposal of the Geological Department for the purchase of models and maps relating to physical geography. A set of thirty relief maps, designed by Professor W. M. Davis of Harvard University, to illustrate the development of the more prominent features in topography, has already been acquired, and a second set, showing the associations of topography with geological structure, prepared by Professor N. S. Shaler, has been ordered. In addition to these, several maps relating to special points in physical geography are in course of preparation. A large model of a unique region in Pennsylvania, showing the effect of valley carving on anticlinal and synclinal structure, is at present under construction by a member of the Pennsylvania Geological survey.

— Emin Pacha, who received serious injuries from a fall soon after reaching the coast, is now in fair way to recovery.

— The slight improvements made from time to time in incandescent electric lamps tend mainly in the direction of giving them a longer life. A lamp of the Woodhouse & Rawson make, as reported from Taunton, England, is credited with a service of 10,608 hours before giving out.

— The fifth annual meeting of the Indiana Academy of Science, to be held at Indianapolis, Dec. 30 and 31, has been announced. The officers and *ex-officio* executive committee of the academy are John C. Branner, president; T. C. Mendenhall, Oliver P. Hay, John L. Campbell, vice-presidents; Amos W. Butler, secretary; Oliver P. Jenkins, treasurer; David S. Jordan, John M. Coulter, J. P. D. John, ex-presidents. The list of papers is as follows: "Explorations of the United States Fish Commission in Colorado and Utah," by David S. Jordan; "Explorations of the United States Fish Commission Steamer 'Albatross' in the Pacific Ocean," by Charles H. Gilbert; "Explorations of the United States Fish Commission in Missouri," by Frank M. Drew and Louis Rettger; "Preliminary Note on the Fishes of the Sandwich Islands," by O. P. Jenkins; "Description of a New Species of Rhinoptera from the Gulf of California" (by title), by B. W. Evermann and O. P. Jenkins; "Some Notes on Indiana Reptiles and Batrachians," by A. W. Butler; "Some Rare Batrachians," by W. S. Blatchley; "Fishes of Putnam County," by O. P. Jenkins; "Some Habits of the Crayfish," by C. W. Hargitt; "The Occurrence of the Badger in Indiana," by Amos W. Butler; "Fishes in the Yellowstone Park," by David S. Jordan; "Notes on Some Fishes from the West Coast of Africa, collected by Carl Stecklemann," by O. P. Jenkins; "Morphology of Siphonophores," by Louis Rettger "Notes upon the Economic Phases of Entomology and Ornithology," by C. W. Hargitt; "Observations on the Destruction of Birds by Storms," by A. W. Butler; "Notes on Indiana Butterflies," by Albert J. Woolman; "Investigations on Relation between the Intensity of Stimulus and Re-action Time," by W. J. Bryan; "Incandescent Gas-Lighting," by W. DeM. Hooper; "Dangers of the Electric Circuit," by John L. Campbell; "Apparatus for the Determination of Power Consumption in Friction and

the Cutting of Metals," "Thomson's Portable Magnetostatic Electrical Measuring Instruments of Long Range," and "On the Determination of the Elasticity Constants of Materials by the Deflection Method," by Thomas Gray; "Preliminary Report on the Changes in Density of Wires on Stretching," by Thomas Gray and C. Leo Mees; "The Use of Two Mirrors for the Determination of Co-efficient of Expansion in Solids," and "Cause of Periodicity in Thermometers as discussed by Professor W. A. Rogers," by C. Leo Mees; "On Sulphophenylpropionic Acid," by Chase Palmer; "Vapor Densities of the Volatile Metallic 'Halids,'" by P. S. Baker; "Soap Analysis," by John F. Schnaible; "The Carbohydrates of the Sweet-Potato," by W. E. Stone; "Oxidation by Means of the Fixed Alkaline Hydrates," and "Action of Chloroform on Aluminium Chloride," by P. S. Baker; "Specific Re-actions for the Penta-Glucoses," by W. E. Stone; "The 'Perkin's Synthesis,'" by P. S. Baker; "Atomic Weight of Oxygen," by W. A. Noyes; presidential address, by John C. Branner; "The State of the Crater of Kilauea in August, 1889," by O. P. Jenkins; "The Moraines of the Maumee Glacier," by C. R. Dryer; "Probable Future of Petroleum in South-western Indiana," by C. A. Waldo; "Observations on the Lakes of Indiana," by C. R. Dryer; "Some Unusual Forms of Lime Carbonate Deposition," by U. F. Glick; "The Top of the Matterhorn," by David S. Jordan; "The Uses of Infinity and Zero in Algebra," by Rufus L. Green; "Variation in Plants from Unripe Seeds," by J. C. Arthur; "Stone Characters of Nyssa," and "Snake Cactus," by Walter H. Evans; "Distribution of Cornus," by John M. Coulter; "The Plants of Putnam County," by D. T. McDougal; "The Compositæ of Vigo County," by W. S. Blatchley; "Germination of the Macrospores of Isoetes," by Douglas H. Campbell; "Some Structures in Epiphegus," by E. M. Fisher; "Mycorhiza and Epiphegus," by John M. Coulter; "Some Remarkable Floral Variations," by C. W. Hargitt; "Some Stem Characters in Compositæ," by Harry D. Seaton; "Some Indiana Mildews," by M. A. Brannon; "On Some Plants New to the State List," by W. S. Blatchley; "Method of Embedding and Staining Delicate Vegetable Tissues," by Douglas H. Campbell; "The National Herbarium," by John M. Coulter; "Plant Reproduction," by W. J. Spillmann; "The Potable Water-Supply of the City of New York," by A. E. Phillips; "The Effects of Trusts," by Jeremiah W. Jenks; "The Proposed Meeting of the American Association for the Advancement of Science at Indianapolis," by Amos W. Butler. The treasurer will be found at the secretary's desk before the beginning and at the close of each session. Applications for membership will be found at the secretary's desk. These should be filled up with the name of the applicant, signed by two members, and given to the chairman of the membership committee, to be appointed at the meeting.

— The Academy of Sciences of Vienna, as we learn from *Nature*, has appointed Professor G. Niemann of Vienna, and Major Steffan of Cassel, to be present as impartial witnesses at the excavations at Hissarlik, begun on Nov. 25, under the direction of Dr. H. Schliemann and Dr. W. Dörpfeld. Capt. Ernst Bötticher, who has often called in question the utility of Dr. Schliemann's archæological investigations, has been requested to take part in the excavations.

— Among recent appointments of graduates of the Johns Hopkins University may be noted the following: G. H. Harold Ballard (A.B., 1888), instructor in the Washington (D.C.) High School; Gustav Bissing (Ph.D., 1885), principal examiner of Division A, United States Patent Office; Benjamin C. Burt (fellow, 1880–81), docent in historical psychology, Clark University; Florian Cajöri (graduate student, 1883–85), instructor in mathematics, Colorado College; William H. Carpenter (fellow by courtesy, 1881–83), assistant professor of German and the Scandinavian languages, Columbia College; Albert S. Cook (associate, 1879–81), professor of English, Yale University; John D. Epes (graduate student, 1888–89), associate professor of English, Centre College, Ky., George Hempl (instructor, 1884–86), assistant professor of English, University of Michigan; William H. Hobbs (Ph.D., 1888), curator of the Geological and Mineralogical Museum, and lecturer on mineralogy and metallurgy in the University of Wisconsin; Cary T. Hutchinson (Ph.D., 1889), electrician, Sprague Electric Company, New York City; James G. Hume (graduate student, 1887–88), professor of mental and moral philosophy, University of Toronto; J. Edward Keeler (A.B., 1881), astronomer, Lick Observatory; George T. Kemp (Ph.D., 1886), associate director of the Department of Physiology and Experimental Therapeutics, Hoagland Laboratory, Brooklyn, N.Y.; William S. Lemen (graduate student, 1886–87, 1888–89), instructor in biology, Indianapolis High School; Gonzalez Lodge (Ph.D., 1886), associate in Latin, Bryn Mawr College; Otto Lugger (curator of the Biological Museum, 1883–85), professor of entomology and agriculture, University of Wisconsin; Robert W. Mahon (Ph.D., 1882), chemist in the Maryland extension of the Pennsylvania Steel Company, in charge of the laboratory of the company at Sparrow's Point, Md.; C. Carroll Marden (A.B., 1889), instructor in French and German, Norfolk (Va.) Academy; Dice McLaren (graduate student, 1888–89), professor of natural history, Maryland Agricultural College; J. Playfair McMurrich (Ph.D., 1885), docent in biology, Clark University; W. Howard Miller (A.B., 1888), teacher, Centerville, Md.; Charles W. Moulton (Ph.D., 1889), professor of chemistry, Shattuck School, Minnesota; Louis Rettger (A.B., 1888), associate in biology, University of Indiana; Thomas H. Spence (matriculate, 1886–88), principal, Snow Hill (Md.) High School; William K. Williams (Ph.D., 1889), assistant in the Boston Athenaeum.

— In a paper read at a meeting of the American Oriental Society in this city in Octobor last, Dr. Cyrus Adler stated that the modern Jewish synagogue has preserved in its ceremonial the use of the shofar or cornet. This instrument is usually made of a ram's horn straightened and flattened by heat. It is not only the solitary ancient musical instrument preserved in the Mosaic ritual, but is the oldest form of wind instrument known to be retained in use in the world. The mode of sounding it has been handed down by tradition. A portion of the liturgy for New Year's Day (on which it is especially employed) refers particularly to the shofar. The Mishna of *Rosh-hash-shana* (New Year) gives minute directions with regard to this portion of the liturgy. It also furnishes instructions as to the kind of horn to be used. A study of the biblical passages shows that it was employed for religious ceremonies, on the day of the year of release, the new moon, the solemn feasts, and that it would assemble all the children of Israel on the day of judgment. It was principally used, however, as a war signal, to call an army together, give warning of an invasion, sound a charge or a release, announce a victory and the coronation of a king. It is rarely mentioned as a musical instrument. Horns of similar construction, with a simple opening at the end, were used by the Etruscans and Greeks (made in bronze), by the aborigines of Brazil (wood), and by the ancient and modern inhabitants of India and the Africans of the Lower Kongo. Seven specimens of Indian and African horns, of cow's horns, and elephant's tusks, are preserved in the United States National Museum. The conclusions were: (1) The oldest wind instrument was the horn of an animal with a natural cavity and a mouth-piece formed by cutting off the end. Horns which required hollowing came into use later. (2) These horns were originally used as signals in time of danger, and for making announcements in general. (3) Many of these important announcements had a religious character. The antiquity of the instrument caused its permanent adoption for sacred purposes. (4) The shofar, speaking especially of the instrument of that name, was originally a trumpet made of the horn of a wild goat. Its especial sacred character may be connected with the sacrificial use made of the goat. (5) The etymology of the word is to be sought in the Assyrian *sappar*, a kind of wild goat: Assyrian *sappartu* meant originally the horn of a *sappar*, and it may afterwards have been used for horn in general.

— According to the annual report of the Department of Mines of New South Wales, the aggregate value of the mineral products of that colony up to the end of 1888 amounted to £76,818,235. The value of such products for 1888 was £3,879,833. The increase in the output of coal, iron, and antimony for the year was considerable, while there was a decrease in the output of gold and copper. The number of miners engaged in gold-mining was 8,460, who took out an average for each man of only about $180. This would seem a small sum for a year's work, were it not for the fact that

many of the miners are engaged during part of each year in other pursuits. Silver-mining is now carried on in every mining disrict in the colony, but the richest and most extensive deposits are at the Barrier Ranges, in the extreme north-west corner of the colony. These deposits extend over a tract more than a hundred miles long by several miles in width. Among other minerals, cobalt, plumbago, and bismuth have been discovered in paying quantities, and are being mined to some extent.

— One of the largest engineering firms in England has undertaken the manufacture of aluminum on an extensive scale by the new Maussier process. This process comprises three distinct periods and kinds of operations, — the desilification, the reduction, and the liquation. The desilification is effected by means of fluorine or fluoride of calcium at a high temperature in the presence of carbon. Lime, or the carbonates of potassium or sodium, may be added to facilitate the decomposition of the silicate. The reduction or expulsion of the oxygen is obtained by means of iron and manganese raised to incandescence in the presence of carbon. The liquation, the object of which is to separate the aluminum from the iron and manganese, is effected by dropping the molten mass into carbon ingot moulds. These moulds are made of wood charcoal. The aluminum so obtained is said to be nearly pure.

— In a paper read before the Johns Hopkins University Philological Association, Nov. 15, 1889, by Leon ibn Abi Suleimân, it was said that American and European scholars who have come in contact with educated Arabs are much surprised to see how well they are informed in regard to European languages, history, and literature, and how little they know of their own native language and its literature. Nor is this wonderful, if we consider the manner in which Arabic is studied by the modern Arabs. The weak points are the incapacity of most of the teachers, and the very imperfect methods they employ, and also the great desire of every Arab to imitate the Europeans, especially the French, as closely as possible, not only in language, but also in dress and mode of life. It is in Syria, especially in Beirut, that the study of Arabic receives more attention than in any other part of the East. Beirut is situated 57 miles west-north-west of Damascus, the capital of Syria, and has about 90,000 inhabitants. Of those, 50,000 are Christians, mostly from the Lebanon Mountains, 4,000 Jews, and the rest Mohammedans. Science and literature are in the hands of the Christian population, whose number daily increases by immigration from the Lebanon Mountains and the adjacent districts. The city of Beirut is widely known as an educational centre, is resorted to by students from all parts of the East, and the pedagogical methods prevalent in its schools may be fairly assumed as representative. Every religious denomination maintains at least one school, where instruction is given either free or for a merely nominal fee. Such schools are frequented by the large middle class. When the Arab leaves his village and comes to the city of Beirut to go to school, he for the first time puts on his red shoes, or rather slippers, which he has hitherto carried carefully under his arm while walking barefooted to church on Sundays. This is his first step toward enlightenment. Having once entered the school, his only desire is to learn French, which is taught in every school; and, were it not that he is obliged to study Arabic, he would certainly not do so. His dislike for this study increases owing to the exceedingly dry and uninteresting manner in which he is taught. After spending nearly two years in learning the alphabet and spelling, he spends three years more in reading the Bible, and all the while no attempt is made to explain to him a single word that he does not understand. Thus far, at least, he in a measure follows what he is reading; but afterwards, when selections from old Arabic poetry are given him to read, his task becomes monotonous in the extreme; for now he does not know whether he is reading Arabic, Turkish, or Persian, and his teacher is absolutely unable to enlighten him, as he himself does not comprehend the meaning of a single passage. We must bear in mind, however, that modern Arabic is just as different from the classical language as modern Greek from classical Greek. After learning to read Arabic poetry fluently, the student enters a class in which the grammar is taught, learning by rote without understanding a word. Writing, like reading, is taught mechanically, and much importance is attached to the acquisition of a good hand. When this has been acquired, the student is given, every two or three weeks, a letter to copy, and thus learns the art of letter-writing. After this he leaves the school, but continues his French and English studies. By this time he has exchanged his *saraweel* for a French suit, addresses his friend "*Ya mon cher*," and tries to speak French whenever he can find or make opportunity. The upper classes, of course, study on a better basis. They usually attend the excellent private schools and colleges with which Beirut is well provided. The foremost of those, and the oldest, is the Madrasat-al-Bustani, the academy of the late Butrus Bustani, the editor of the famous dictionary "Muhit-al-Muhit." This school, the American College, and the University of the Jesuits, are considered the best. But in these also, European languages hold the foremost place, and students desiring of devoting themselves to the study of classical Arabic do so privately after leaving college, studying the Koran, not taught in any school, the old grammarians, even now the best, and trying to imitate in their writings the language of the Koran, so pleasing to the ear of the cultivated Arabic scholar. Such men form the several literary societies, among which the Zahrat-al-Adâb is the most prominent. But few Arabs can be said to possess a fair knowledge of their own literature. The example, however, of those who devote themselves to this study is beginning to be felt, and the system of the schools is daily becoming better. Nevertheless it will be long before the study of Arabic in the East will be established on a true scientific basis.

— At a recent meeting of the American Oriental Society, after a brief introduction describing the opinions held by various scholars that there was a connection between the aborigines of China and Mesopotamia, an account was given by Dr. Cyrus Adler of a paper by Mr. Yonekichi Miyake, in a Japanese literary journal, in which he compared an ancient golden banner preserved at the celebrated Buddhist temple Horinji, in the province of Yamato, Japan, with designs on Assyrian and Hittite monuments. The conclusion of the author is, "that there once existed inter-continental communication in Asia, and that the Assyrian art was introduced into China probably through Persia and India. Although Japan is entirely separated from the continent, it came under this influence, by way of China, about 1000 years ago."

— A correspondent of *Garden and Forest* sends the following note upon *Magnolia glauca* in its isolated northern station in Essex County, Mass.: "Magnolia Swamp contains several hundred acres, and it is one and a half miles in length and from ten to over one hundred rods in width. I am of opinion that this swamp has furnished the shrub to all the others. In regard to three of the smaller swamps, I know that this is a fact, the magnolia shrubs having been transplanted by men. The inhabitants of Gloucester are firm in the belief that *Magnolia glauca* is a native shrub, but I cannot think so. I believe it was introduced by the old settlers, some of whom may have lived in and removed from a more southern State. 'The old Salem road,' deserted by the travelling public for over a hundred years, skirts the eastern side of Magnolia Swamp. Along the line of this road are the ruins of old cellars, and in the swamp opposite one of the cellars, near a spring, may be found magnolias which appear the oldest in the region. The root-crowns below the moss are often found to be two feet in diameter. In no other place can I find such a growth, and it is here, I think, that the shrub first started. It must be evident to any careful observer that *Magnolia glauca* is struggling here in an unnatural climate. The primary roots grow straight down into the muck, and in the fall are thickly covered with rootlets snowy white in color. In the spring these rootlets are mostly dead, and a greater part of young shoots die down to the moss, and a certain per cent of the old plants are winter-killed, which indicates that there is no harmony between shrub and climate."

— The fruit of the Japanese persimmon or kaki can still be found in the markets of this city in great abundance, and of extraordinary beauty and excellence. It is raised in Florida and Georgia, where the kaki has been planted in large quantities. According to *Garden and Forest*, it is by far the handsomest dessert fruit which the market affords at this season of the year; but it is a question

whether the kaki really possesses as good a flavor as one of our thoroughly ripened and frosted native persimmons from Georgia or Virginia, a fruit which some people consider about the best that grows. A cross between the American and Japanese species might be expected to produce a fruit of larger size and finer color than that of the former, and with a richer flavor than any of the cultivated forms of kaki. The Asiatic persimmon, according to Rein, is "undeniably the most widely distributed, most important, and most beautiful fruit-tree in Japan, Corea, and northern China. In Japan it endures night frosts at a temperature of from 12° to 16° C. It can be cultivated high up in the valleys, and far beyond the limit of the bamboo cane. It is a stately tree, after the fashion of a pear-tree, with beautiful deciduous leaves, almost as large as those of some magnolias, but of bright green color, and resembling those of the pear in shape only. The new leaves come in May. It blossoms in June. The season of ripe fruit is late in autumn, from the middle of September to the end of November. There are many kinds of kaki, ranging in size from a small hen's egg to a big apple. Some are nearly spherical, others oblong, others heart-shaped. In color of the outer skin, they run from light orange-yellow to deep orange-red. They are distinguished also by their taste, which is pleasant in its way, and reminds one of tomato, as does the color also. They are not only eaten in a soft, doughy condition, in which those of the Migako-no-djô, in the province of Hiuga, are prized most highly, but the fruit is gathered while still hard, to ripen afterward. The best in Japanese estimation are *Tarugaki*, that is, 'tub persimmons,' which have been converted from astringent into sweet fruit by being kept in an old saké tub. The bitter, astringent taste of all green kaki remains, even in the ripe fruit, in the case of most varieties; and it is from these that, during the summer, an astringent fluid, rich in tannin, is prepared (called Shibu), — an acid of considerable importance in several industries. When over-ripe and dried in the sun, pressed somewhat flat, and then put away in boxes, the sweet kaki get to look and taste in a few months, when skinned, like dried figs, and are used like them. The white powder which covers these dried persimmons in boxes is natural sugar that has exuded from the fruit. In September the kaki-tree, laden with a large, orange-colored fruit, is a great ornament to the landscape. This beauty it preserves till it loses its leaves in October."

—The great utility of the electric light on vessels passing through the Suez Canal is shown by the fact that during the year 1888 the average time occupied by vessels in passing through was 37 hours 57 minutes, when the boats in question were not fitted with the electric light, and 22 hours 32 minutes for those vessels so fitted, which are then able to proceed at night. The saving effected in the time of transit is therefore very considerable, and the use of the electric light is rapidly spreading. During the first three months of the year 295 vessels thus fitted passed through the canal, but during the last three months the number had increased to 519.

— On Wednesday evening, Dec. 11, a preliminary meeting was held at St. Paul, Minn., for the purpose of organizing a scientific society. A few years since, the St. Paul Academy of Natural Sciences was totally destroyed by fire, losing a valuable library and museum. From this loss it has never recovered, a subsequent effort to renew its operations not meeting with success. It is exceedingly gratifying now to note that the present movement develops unexpected strength, and from a larger number than ever before. A chairman and secretary, with a committee of twelve, were named to draught articles of organization and report early in January, when several hundred memberships are expected. It is also interesting to note, that, in connection with the work usually planned for an institution of this kind, the idea of forming a series of classes in different branches of science, with special reference to elementary and practical study, seems to receive unanimous support. This will be substantially the same scheme as the "University School Extension System," which is producing handsome results.

— The American Historical Association will hold its sixth annual meeting, Dec. 28–31, in the city of Washington, D.C. The evening sessions will be in the lecture-room of the Columbian University, 15th Street, where the association met during the Christmas holidays last year. The morning sessions will be in the lecture-room of the National Museum, by permission of the Board of Regents of the Smithsonian Institution. The recent incorporation of the association by Congress, and the relation now established between the society and the Smithsonian Institution, make it especially desirable that the members should convene again in the Federal city. The headquarters of the association will be at The Arlington, where accommodations are promised to members of the association at reduced rates. Members are expected to make their own arrangements at this hotel or elsewhere. Round trip tickets from New York to Washington, *via* the Pennsylvania or the Baltimore and Ohio Railroad, are sold in New York for ten dollars. The advantages of Washington as a meeting-place for a national historical society are very obvious. The attractions of the capital in winter, the opportunity of easy access to public record offices and the Congressional Library, the general interest of the government buildings, the National Museum, etc., — all combine to make a visit to Washington at once a pleasure and an advantage to students of American history. The holiday season was chosen by the committee on time and place, because it is generally convenient for members, and it is easier at that time to obtain good hotel accommodations, Congress not being in session. There will be time in the afternoon hours for members to engage in private conference, in visiting, or sight-seeing, for the literary exercises are restricted to morning and evening sessions. One of the great advantages of this annual meeting of the association is the opportunity for members to meet one another in a social way, and to discuss matters of common interest. Special courtesies will be extended to the association by the Cosmos Club and by the Hon. Horatio King of Washington, D.C. The programme is as follows: Saturday, Dec. 28, "The Literature of Witchcraft," by Professor George L. Burr, Cornell University; "The Journalism of the French Revolution," by Ex-President Andrew D. White, Ithaca, N.Y.; "The French Revolution in San Domingo," by Herbert Elmer Mills, instructor in history, Cornell University; "A Newly Discovered Manuscript, 'Reminiscences of the American War of Independence, by Ludwig, Baron von Closen, Aide to Count de Rochambeau,'" by Clarence Winthrop Bowen; "Recent Historical Work of the Universities" (inaugural address), by Charles Kendall Adams, president of the American Historical Association; "Historical Survivals in Morocco," by Talcott Williams of Philadelphia. Monday, Dec. 30, "The Origin and Early History of our National Scientific Institutions," by Dr. G. Brown Goode, assistant secretary of the Smithsonian Institution; "The Development of International Law as to Newly Discovered Territory," by W. B. Scaife; "The Impeachment and Trial of President Johnson," by Dr. William A. Dunning, Columbia College, New York; "The Trial and Execution of John Brown," by Gen. Marcus J. Wright, War Records Office, Washington; "A Defence of Congressional Government," by Dr. Freeman Snow of Harvard University; "The Economic and Social History of New England, 1620–1789," by William B. Weeden, president of the Brown University Historical and Economic Association; "Correspondence of the Pelham Family and the Loss of Oswego to the British," by William Henry Smith, Associated Press, New York; "Early History of the Ballot in Connecticut," by Professor Simeon E. Baldwin of the Law Department, Yale University; "Certain Phases of the Westward Movement during the Revolutionary War," by Theodore Roosevelt, civil service commissioner. Tuesday, Dec. 31, "Bacon's Rebellion," by Edward Eggleston; "The Constitutional Aspects of Kentucky's Struggle for Autonomy, 1784–92," by Ethelbert D. Warfield, president of Miami University, Oxford, O.; "Facts from the Records of William and Mary College," by President Lyon G. Tyler, Williamsburg, Va.; "Materials for the Study of the Govment of the Confederate States," by John Osborne Sumner, A.B., Harvard University; "Notes on the Outlook for Historical Studies in the South," by Professor William P. Trent of the University of the South, Sewanee, Tenn.; "Report on the Bibliography of the American Historical Association," by Paul Leicester Ford of Brooklyn; "The Spirit of Research," by James Schouler of Boston; "The Perils of Historical Study," by Justin Winsor, librarian of Harvard University; "The Government as a Guardian of American History," by Worthington C. Ford of Washington.

SCIENCE:

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author n request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VOL. XIV. NEW YORK, DECEMBER 27, 1889. No. 360

CONTENTS:

BOOK-REVIEWS.

A Text-Book of Animal Physiology. By WESLEY MILLS. New York, Appleton. 8°.

UP to the present time no work on physiology has been written which has been based on the comparative method. Hardly a book which treats of zoölogy has been published, within recent years, but has this method as a foundation. The book before us is an attempt on the part of the author to do for physiology what has already been done for morphology. In his preface he calls attention to an error which is found in too many works on human physiology, — the application to man of conclusions which have been deduced from experiments on lower animals. That this is thoroughly illogical goes without saying, and yet many writers of physiological text-books constantly err in this direction.

Professor Mills commences his treatment of the subject with the consideration of general biology, describing the cell, both animal and vegetable, and then passing on to unicellalar, parasitic, and multicellular organisms. The origin of the forms of life finds a place in the author's plan for a concise and yet sufficiently extensive statement of the arguments of evolution. Reproduction, which is usually left until the last subject for consideration, is taken up early for discussion, and this portion of the work is one of the best. The general treatment of special physiology is excellent. The "summary" which is found at the conclusion of each subject treated is a most valuable addition. Especially worthy of commendation is the table of contents, than which we do not remember ever to have seen one more full or more convenient for reference. The five hundred illustrations are well selected and admirably executed. As a whole, this text-book will be acceptable to all teachers and students of physiology, and, as it contains matter not found in any book on the subject which has as yet appeared, no other can take its place. It certainly deserves the name of being unique, especially in the plan upon which it is written.

The Lost Inca. A Tale of Discovery in the Vale of the Inti-Mayu. By the INCA-PANCHO-OZOLLO. New York, Cassell. 12°.

THIS is a pleasing novel by a writer evidently possessed of more genius than art, who hides his identity behind a pseudonyme, and makes himself the hero of his own story. The scene is laid in the Peru of the present, geographically modified to meet the demands of the occasion, and the action is a curious blending of the past with the present, and the possibilities of the future. Peru is a land rich in romantic traditions, which are lifted from the realm of fiction by the evidences of her antiquities; and it is strange that novelists, to whom these traditions should be suggestive and fruitful material, have so long neglected them.

The writer of this novel, who has evidently travelled in Peru, and given some attention to its antiquities and traditions, bases his work upon the mysterious disappearance of Manco-Capac, the last of the Incas, from the presence of his conquerors, as detailed by Prescott in his "Conquest of Peru." In working out his plot, the author sometimes outdoes Jules Verne in his inventions, though his evident lack of patient attention to details, so characteristic of that author, leads him into blunders that will furnish mirth to historians, engineers, and electricians. For instance, he travels on the Mollendo and Puño Railroad some three years before the contract for its construction was signed. Reaching Lake Titicaca, he embarks on a flat-bottomed, stern-wheel steamboat, constructed some time previously, under his own supervision, at Wilmington on the Delaware. One of the peculiar features of this boat is that the engines are located on the upper deck, amidships. Besides the engines, she was provided with electric motors, "served by six immense storing batteries disposed symmetrically on both sides the kelson." These batteries are charged by the "economical utilization of the nearly constant north-east winds of the lake, which generated electricity by means of machinery designed for the purpose." This was in 1865. But these are only slight flaws. When the author reaches the hidden fastnesses of the Lost Inca's ideal kingdom, all is beyond criticism. Here Verne, Bellamy, and Henry George seem to have combined forces in an attempt to improve on More's Utopia, and the result might furnish suggestions to Edison as an inventor and to Ingersoll as a reformer. The book is certainly interesting and edifying, if not instructive.

AMONG THE PUBLISHERS.

AMONG the contents of *Outing* for January, we note "Wabun Anung," a tale of sport in the Great Lake region, by F. Houghton; "The Merits and Defects of the National Guard," by Lieut. W. R. Hamilton (second paper); "Gymnastics for Ladies," by W. G. Anderson, M.D.; "Fly-catcher," a tale of the hunt cup, by Hawley Smart; "Brant Shooting on Smith's Island," by Alexander Hunter; "Haak Fishing off Ireland's Eye," by Robert F. Walsh; "Alligator Shooting in Florida," by J. M. Murphy; "California Winter Resorts," by C. H. Shinn; "Ice Yachting, the Prospects of the Sport," by W. W. Howard; "Catching Frost Fish with a Shot-Gun," a story of Australian sport, by Edward Wakefield; and "Instantaneous Photography," by W. I. Lincoln Adams.

— P. Blakiston, Son, & Co., medical and scientific publishers, booksellers and importers, 1012 Walnut Street, Philadelphia, will publish in January "Massage and the Original Swedish Movements: their Application to Various Diseases of the Body," a manual for students, nurses, and physicians, by Kurre W. Ostrom, from the Royal University of Upsala, Sweden; a text-book on mental diseases, having special reference to the pathological aspects of insanity, by Bevan Lewis, medical director, West Riding

Asylum, Wakefield, England; and "A Manual for Nurses," being a complete text-book, including general anatomy and physiology, management of the sick-room, etc., by Laurence Humphrey, assistant physician to, and lecturer at, Addenbrook's Hospital, Cambridge, England.

— A. D. F. Randolph & Co. have in press a work on "The Bible and Modern Discoveries," by Henry A. Harper.

— The J. G. Cupples Company will publish shortly a volume of European travel, entitled "A Bundle of Letters from Over the Sea," by Louise B. Robinson, well known in artistic and social circles of Boston.

— P. Blakiston, Son, & Co., Philadelphia, announce that they have arranged with the London publishers to reprint here a new text-book on anatomy, by Professsor Alexander Macalister of the University of Cambridge.

— A catalogue of a collection of books, comprising Americana, including many rare genealogies and local histories, natural history, biography, numismatics, occult sciences, South America, the West Indies, etc., was issued under date of Dec. 15, 1889, by S. H. Chadbourne, Hotel Dartmouth, 57 Warren Street, Roxbury, Mass.

— As a memorial of a distinguished administrator, and to further the cause of imperial federation, Mr. Stanley Lane-Poole has edited the paners of Sir George Bowen, and they will be published immediately in London and New York by Longmans, Green, & Co. In one of Sir George's earlier letters there is a pleasant glimpse of Washington society during Grant's administration.

— The Open Court Publishing Company of Chicago announces the immediate appearance of the authorized translation of M. Th. Ribot's "Psychology of Attention." The monograph of M. Ribot, who is now professor of experimental and comparative psychology at the Collège de France, and editor of the *Revue Philosophique*, has been characterized by a prominent French critic as the most important production of the French philosophical press for the present year.

— Dr. Holmes's "Over the Teacups," and the first instalment of Mr. Frank Gaylord Cook's series of papers on "Forgotten Political Celebrities," are in the *Atlantic* for January. Dr. Holmes writes about old age. He says, "There is one gratification an old author can afford a certain class of critics, — that, namely, of comparing him as he is with what he was. If the ablest of them will only write long enough, and keep on writing, there is no pop-gun that cannot reach him." Another political article, "The United States Pension Office," by Gaillard Hunt, contains suggestions as to the reform of the present pension system. "A Precursor of Milton," a certain Avitus, Bishop of Vienne in the fifth century, forms also the subject of one paper.

— The *Critic* announces that with the new year Dr. W. J. Rolfe of Cambridgeport, Mass., the distinguished Shakspearian scholar, will take charge of a department in that paper to be entitled "Shakspeariana." In this department he will review new editions of Shakspeare's works, together with new publications relating to those works and their author, and will answer any questions concerning them that show an intelligent interest in the subject on the part of the inquirer. The study of Shakspeare has assumed such proportions nowadays as to demand special treatment in literary journals of a serious character. Dr. Rolfe will edit the Shakspearian department of no other periodical while he has charge of the one to be opened next month in the *Critic*.

— Mr. Edward Atkinson will open the January *Popular Science Monthly* with a paper on "The Future Situs of the Cotton-Manufacture of the United States," in which he answers the questions whether the number of spindles in this country is being increased faster than the demand for their products, and whether the South is likely to become a formidable competitor of New England in the cotton-manufacture. A series of six Chinese pictures, illustrating the processes of cotton-manufacture in China, embellish the article. Herbert Spencer was recently quoted in the London *Times* as favoring the nationalization of land, which drew out a letter from him repudiating the doctrine as ascribed to him. This led to a lively discussion, in which Professor Huxley, Sir Louis Mallet, and others took part, and a variety of views on the general question were expressed. The correspondence will be printed in the same number under the title "Letters on the Land Question." "Public Schools as affecting Crime and Vice" is the title of another article, by Benjamin Reece, to appear in this number. Mr. Reece cites figures which show that crime does not decrease as illiteracy is diminished, and says that our school system should be made more effective by the addition of moral teaching. An interesting account of the "Irrigation of Arid Lands" in the Far West will be given by Henry J. Philpott. The effect which this practice has on the methods of agriculture, the interest of farmers in the science of meteorology, and on state and national legislation, are also brought out in the article.

— Houghton, Mifflin, & Co. have nearly ready the concluding volume of Justin Winsor's valuable "Narrative and Critical History of America." It covers the later history of British, Spanish, and Portuguese America. A general index accompanies it. They will also publish at an early day a new brochure by Professor E. N. Horsford, on "The Discovery of the Ancient City of Norumbega." The substance of the book was communicated to the president and council of the American Geographical Society, at a special session in Watertown, on the 21st of November last. In addition to the historical address, there will be photographs of the site of the ancient city, sixteen maps from Icelandic sources down to the United States Coast Survey, and an original map of the valley of the Charles River from Stony Brook to Cambridge. The book will also include the "Poem of Vinland," delivered at Watertown by Mr. E. H. Clements of the Boston *Transcript*.

— The fourth number of the second volume of the *American Journal of Psychology*, just at hand, contains an interesting collection of folk-tales of the Bahama Islands, by Charles L. Edwards; a critical exposition of the characteristics of symbolic logic, by Christine Ladd Franklin; and the concluding chapter of Dr. W. H. Burnham's historical study of memory, this chapter dealing with recent theories and the results of experiment, and closing with an extended bibliography of the whole topic; the usual fifty odd pages of reviews, abstracts and notes on the nervous system (by Dr. H. H. Donaldson), experimental psychology (including an original paper on colored shadows by E. B. Delabarre), hypnotism, etc., covering from seventy-five to eighty books and articles. The notes are followed in this number by a brief survey, by the editor, of progress in the psychological field during the two years of the journal's existence. With the first number of Vol. III., to appear in January, 1890, material changes in the form of the journal are promised, and a new department will be added. Special efforts will be made not only to enlarge the scope and improve the quality of the journal, but more attention will be given to foreign work in psychological lines. During Dr. Hall's recent year in Europe, he was at pains to make such foreign connections as will forward this end. In Vol. III. the following larger contributions will appear: a very detailed examination of the brain of Laura Bridgman, several studies in paranoia and other rare and borderland forms of mental alienation, a continued history of reflex action, and a series of articles embracing reviews of recent and important literature on heredity and the psychology of sex. It is probable, also, that the educational material will be increased on both its psychological and university sides. During the past year the journal has been under the efficient editorial care of Dr. E. C. Sanford: with the next number Dr. Hall will re-assume personal direction, and will probably associate with himself in the editorial work other well-known psychologists.

— *The Ladies' Home Journal* (Philadelphia) has secured its large circulation by believing in woman and home as the two greatest factors of human life. It has aimed to cover every department of life in which women are interested. Its purpose has been to make woman's daily life easer and brighter. The actual circulation is said to be 542,500 copies per month in 1889. For 1890 the journal has a most promising prospectus, including among many others such features and authors as "Two Sides of Washington Life," by two of the "most famous women" at the nation's capital, telling of the trials and pleasures of official and social life in Washington; "New York Fashionable Life and Women" as seen by Mrs. John Sherwood; "Woman's Life in Foreign Lands," by sev-

eral writers now travelling in Europe; "Mrs. Harrison in the White House," — a paper telling of the daily life of the President's wife, — authorized by Mrs. Harrison, and written by one of the attachés of the White House; "Mary J. Holmes's Travels Abroad," in European capitals and countries. Articles by such writers as Mrs. Lew Wallace, Elizabeth B. Custer, Blanche Willis Howard, Julia Ward Howe, Harriet Prescott Spofford, Susan Coolidge, Dr. William A. Hammond, Anna Katharine Green, Mrs. Henry Ward Beecher, Grace Greenwood, Ella Wheeler Wilcox, Margaret J. Preston, Rev. Robert Collyer, D.D., and Kate Upson Clarke, will be features of each number. The new regular department by Rev. T. De Witt Talmage, D.D., we have already referred to. In this the famous preacher will talk on all subjects of interest to woman. The department will be called "Under my Study Lamp." Fifteen departments for woman's daily life will be sustained by the journal, including "Side-Talks with Girls," "Practical Housekeeping," "Artistic Needlework," "The Latest Fashions," "All about Flowers," "Facts for Mothers."

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Is Man Left-Legged?

IN view of the subjoined facts and remarks, we would seem justified in awaiting the presentation of more statistics and investigations, before giving an affirmative answer to the above query.

1. Of over fifty men questioned by the writer, every one answered that he would kick a foot-ball with his right foot, except two, one of whom was left-handed, the other ambidextrous; and out of forty boys interrogated by the school superintendent here, thirty-eight kicked with the right foot, and the two others equally well with either foot, both being ambidextrous.

2. About half of those asked took the spring, in leaping, from the right foot, and alighted on the left; the other half, the reverse. The strain and force required in either case seem about equal.

3. Every shoe-merchant of this place testified that nearly all their customers preferred trying a new boot or shoe on the right foot, considering that one the larger, especially in breadth.

4. Standing on either leg, and using it more, would rather tend to consolidate the bone, and develop the muscle, of that leg: hence the somewhat increased length of the left leg, indicated by Dr. Sibley, might denote comparative weakness. Besides, if the greater length of the leg is admitted as evidence of left-leggedness, by parity of reasoning, we should find the right arm, on right-handed people, longer than the left; which, from such evidence as the writer has been able to obtain, is not the case.

5. The recruit is taught, at the word "forward," to throw his weight on the right foot; and, at the word "march," to step off with the left. This position, in olden warfare, would be favorable for the use of the shield, the spear, and the cross-bow, and in modern times is equally appropriate for a bayonet charge or for firing, by right-handed men. In dancing, the instructions are invariably to begin the "chassez," and similar movements, with the right foot. Piano and harp pedals, besides various treadles for harvesters and other agricultural implements, etc., are usually made to accommodate the right foot.

6. That man is naturally right-handed, is stated to arise from a physiological cause (see Bell's "Bridgewater Treatise on the Hand," or McClintock's "Biblical Cyclopædia," when commenting on the ambidextrous Benjamites); and the same cause would be likely to strengthen the whole side, including leg and foot.

7. In the West, our race-courses, quite as often as otherwise, are so arranged as to make the horse and rider, or sulky driver, curve to the left. Circus-riders invariably follow the left-hand curve, in order to mount and dismount on the near side. The reason for generally mounting on the left is obvious. Every right-handed man, in going to battle, has his sword in scabbard on his left side, and seizes his bridle-rein with his left hand: hence the necessity of mounting from the near side, and placing the left foot in the stirrup, but all the weight comes on the right stirrup, when wielding the sabre, battle-axe, or lance; and the lunge with the foil or small-sword is made with the right foot, by right-handed men.

8. As in dancing the lady is on the right of her partner, naturally in "hands round" or "balance all," or in the first movement of the waltz, the turn is to the right; but in each case the circle pursued is a left-hand curve: so that the argument on that point seems to have little force.

9. Backwoodsmen state, that, when lost in the forest, they usually find they have wandered in a left-hand curve, and come back nearly to the place of starting; and experiments in wheeling a wheel-barrow when blindfolded usually result in the stronger right leg gaining on the left, thus producing an inclination to the left hand.

If the officers of athletic college-clubs at Harvard, Yale, Princeton, etc., would be kind enough to report to *Science* the percentage of those students who kick the foot-ball with the right foot, and the comparative measure between the right and left leg in circumference around the muscular portion, it would aid much in arriving at the truth, especially if the small percentage kicking with the left proved to be either left-handed or ambidextrous.

RICHARD OWEN, M.D.

New Harmony, Ind., Dec. 20.

On Physical Fields.

WHEN the physical state of a body re-acts upon the medium that surrounds it so as to produce in the medium a state of stress or motion, or both, the space within which such effects are produced is called the "field" of the body. When a body is made to assume two or more physical states simultaneously, each state produces its own field independent of the existence of the others: hence two or more fields may co-exist in the same space. For instance: if a magnet be electrified, both the magnetic and the electric fields occupy the same space, and each as if the other did not exist.

PROPERTY OF VARIOUS FIELDS.

I. The Electric Field. — Suppose a glass rod be electrified with silk or cat skin. It is experimentally known that other bodies in its neighborhood are physically affected by its mere presence without contact, and various motions result which are commonly attributed to electric attraction or repulsion. The phenomena are explained as due to the stress into which the neighboring ether is thrown by the electrified body, the stress re-acting upon other bodies, and moving them this way or that as the stress is greater here or there. Suppose an electrified mass of matter remote from any other matter, in free space. The field, or the stress that constitutes it, is found to vary in strength inversely as the square of the distance from the body in every direction about it, which shows that the effect upon the ether is uniform in all directions, and that for such a stress under such conditions the ether is isotropic. Experiment shows that this kind of a stress travels outwards with the velocity of 186,000 miles a second, or the same as that of light, which shows that the velocity of motion in the ether depends solely upon the properties of the ether, and not at all upon the source of the disturbance. If this assumed electrified mass of matter were the only matter in the universe, then its electric field would be as extensive as the universe, and any electric change in the mass would ultimately re-act upon the whole of space, and be uniform in every direction. If, however, there be another mass of matter in proximity to the first, the disposition of the stress is altogether different; for instead of being disposed radially, as in the first case, the field is distorted by the re-action of the stressed ether upon the second body. The so-called "lines of force" bend more or less towards the second body, and the field stress becomes denser between the bodies at the expense of the field more remote. If this advancing stress in the ether from an electrified body be called radiation, and it seems to be an action of that kind, then it appears that the direction of such radiation depends upon the existence of other bodies in the ether. It is truly rectilinear no further than the shortest distance between the two bodies.

The electric field thus produced, and thus re-acting upon an-

other body, develops in the latter an electrical condition, that is to say, it electrifies it; and the process we call "electric induction," to distinguish it from the transferrence of the electrification by contact, which is called "conduction." In the process called induction there are two transformations: in conduction there is simply a transferrence, and no transformation. The experimental fact is this: an electrified body sets up in the ether a stress of such a nature, that, by its re-action upon another body, the latter is brought into a condition similar to that of the first; that is, it electrifies it.

II. The Magnetic Field. — A magnet in like manner sets up in the ether a stress that is propagated outwards with the velocity of light. The physical character of this stress is such that iron and some other substances upon which it can re-act are thereby rendered magnetic. Their molecules are re-arranged. On the supposition that a piece of iron were suddenly magnetized in any way remote from any magnetizable substance, the magnetic field would spread radially, having a spherical surface. As soon, however, as a piece of magnetizable substance was reached, the re-action of the ether upon it would begin; and the so-called magnetic lines of force will now be curves, and the equipotential surfaces will no longer be spherical. The distortion will depend upon the size, shape, and quality of the second body, as well as upon the strength of the field.

This process is called "magnetic induction." The magnetic field differs from the electric field in this important particular: the latter has no selective property, but re-acts upon all substances, while the magnetic field re-acts upon iron and a few other substances, and but slightly, if at all, upon most bodies. They are alike, however, in this: their equipotential surfaces are determined by the presence or absence of other bodies.

A magnet then sets up such a physical condition in the ether, that its re-action upon another body brings the latter into a condition similar to that of the first; that is, it magnetizes it.

III. — The Thermal Field. — An isolated hot body becomes cool by a process called radiation. It is explained by saying that the atomic and molecular vibratory motions that constitute the heat of the body, set up undulatory motions in the ether. These undulations are propagated with the velocity of light, certain wave-lengths being light. The path of a ray is straight, and is continued indefinitely outwards, to the boundary of the universe if there be a boundary; if not, then to an infinite distance. A hot body has a field, as well as an electrified or a magnetized body.

Experimentally we know that when these undulatory motions called rays fall upon other matter, it becomes heated in consequence; and we also know that the energy acquired by the second body from the radiations depends rigorously upon the area exposed to them. It is customary to say that the intensity of light varies inversely as the square of the distance from the source, when intensity means energy. This is true, however, only for equal intervals of time; for if a body at unit distance was exposed to radiations from a constant source for one second, and another similar body at double the distance was exposed for four seconds, each unit of surface would have received the same amount of light or radiant energy.

The presence or absence of another body in the thermal field makes no difference in the strength of the field in other directions: in other words, the absorption of radiant energy of this sort makes no manner of difference in the direction of other rays that have not been stopped. I am not aware of the existence of any evidence that a ray of radiant energy of any wave-length is ever deflected from its rectilinear course except by a change in the density of the medium through which it passes, and not then if the incidence be normal. In this respect the thermal field is entirely unlike the other two fields. In addition to this, let it be remembered that a hot body continues to impart its energy to the ether until its income equals its expenditure, according to Prevost's law of exchanges: so, if there were but a single hot body in the universe, it would impart its energy to the ether, and approach infinitely near absolute zero; while an electrified body or a magnet would be perfectly insulated, and, so far as is known, would lose none of

its properties, however long it was thus kept. There is no static condition in heat phenomena: exchange is constant. These facts indicate that light or radiant energy is no more an electromagnetic phenomenon than magnetism is a thermal phenomenon, but that it is one of a distinct order.

That point is inmaterial here, for what I wish to call attention to is the fact that a heated body sets up in the ether such a physical condition that its re-action upon another body brings the latter to a condition similar to the first; that is, it heats it.

IV. The Acoustic Field.— There is another physical field with which all are acquainted, though it has not hitherto been called by that name. I refer to the phenomena of sound. Suppose a bell be struck: sound-waves in air are formed, that travel outwards, and have the same geometrical space relations that other fields have. So long as the medium is uniform, the field is uniform, and the energy of the sound-waves per unit surface and unit time varies inversely as the square of the distance from the source. When such sound-waves fall upon other masses of matter, they are absorbed and reflected. Those that are absorbed set the body in vibratory motion similar to the original vibrating body; that is to say, they produce sound. If such second body upon which the waves fall happens to have its own vibratory rate in accordance with the time-rate of the incident waves, the effect is cumulative, and the body may be made to visibly as well as audibly vibrate. If not, the vibrations are said to be forced vibrations; but in every case every body in an acoustic field is made to vibrate. Now, there is the same distinction between the vibratory motions of the bell and the air-waves that result from them as there is between heated molecules and the undulations in the ether; but acoustical terminology has not hitherto been so seriously incommoded hy the failure to make the distinction as has been the case with heat phenomena. As sound phenomena are treated as special cases in kinetics, the space within which sound-waves are produced by the vibratory motions of a body may be spoken of as the acoustic field; and here, as in the other three cases, we have the fact that a sounding body sets up in the medium about it such a physical condition as, by its re-action upon another body, brings the latter into a vibratory state like the first.

These various physical relations may be thus generalized: when a mass of matter acts upon the medium that is about it, the latter is thrown into such a physical conditition or state that its re-action upon another body always induces in the second body a state similar to that of the first body. This has a much wider application than most physical laws; for it embraces phenomena in mechanics, heat, light, electricity, and magnetism. A. E. DOLBEAR.

Tufts College, Dec. 21.

The Waters of the Great Salt Lake.

LONG before white men first trod the shores of the Great Salt Lake, strange stories of this inland sea had found their way into the civilized regions of our own land, and even beyond the ocean. The earliest record of the lake was made in 1689 by the traveller, Le Hontan, who relied for his information upon the wild tales told by the Indian tribes of the Mississippi valley. In 1843, however, the lake was visited, its shores explored, and its waters navigated, by Gen. Frémont, of extensive fame. Six years later (1849–50) a fuller survey was made under the personal direction of Capt. Howard Stansbury, U.S.A., whose report, "Expedition to the Valley of the Great Salt Lake," issued at Washington in 1853.

The Great Salt Lake is by far the largest body of water existing in the "Great Basin." Its average length is seventy-five miles; and its width, forty miles. The altitude of the lake is near forty-two hundred feet above sea-level, and the region is declared by geologists to be still rising.

Even a hasty examination of the Salt Lake valley will convince the observer that the present lake is but the shrunken remnant of a vastly larger body of water, which at one time stretched far beyond the limits of the valley. This former sea was a feature of quaternary times, and has been named Lake Bonneville. It extended beyond the Idaho line on the north, invaded Nevada on the west, and closely approached the Arizona boundary on the south. Of this great body, Utah Lake and Sevier Lake, now existing as distinct occurrences in the regions south, were but comparatively small bays. Numerous water-lines are visible along the mountains adjacent to the Salt Lake, the highest of which is about one thousand feet above the present water surface; and the evidence of wave-action along this ancient shore is abundant.

The history of Lake Bonneville, as recorded on the stony pages of its precipitous shores, and in the hardened sediments of its floor, is more complicated than a mere recital of the shrinking and falling of waters through evaporation and other wasting causes. For most of our knowledge upon this subject, we are indebted to the detailed observation and study conducted by the United States Government Survey corps, and especially to the investigations carried on under the direction of Major J. W. Powell. Referring to the labors of Mr. C. K. Gilbert and his associates in the lake region, Director Powell thus briefly summarizes the history of Lake Bonneville: —

"First, the waters were low, occupying, as Great Salt Lake now does, only a limited portion of the bottom of the basin. Then they gradually rose and spread, forming an inland sea, nearly equal to Lake Huron in extent,,with a maximum depth of one thousand feet. Then the waters fell, and the lake not merely dwindled in size, but absolutely disappeared, leaving a plain even more desolate than the Great Salt Lake Desert of to-day. Then they again rose, surpassing even their former height, and eventually overflowing the basin at its northern edge, sending a tributary stream to the Columbia River; and, last, there was a second recession, and the waters shrunk away, until now only Great Salt Lake and two smaller lakes remain."

As is clearly understood, the oscillations of the water in a lake possessing no outlet will be far more marked than in an opposite case. In a body of water with an outflow, a tolerably uniform level will be maintained, the irregularities in the supply being compensated for the most part by the varying volume of water flowing away; but the level of a lake completely enclosed will be due to the relation existing between the supply of water and the rate of evaporation. The topography of the ancient shore-line of the Great Salt Lake shows, that since the time of the "second recession" of the waters, referred to by Major Powell in the quotation made above, the lake has been unable to find an outlet for its contents, and has consequently reached its present diminutive proportions through loss by evaporation alone. The composition of the water would necessarily vary with the concentration. The analysis most commonly accepted, and which forms, indeed, the basis for current quotations and references, is that made by Dr. Gale, and published in Stansbury's report. Gale found the water to possess a specific gravity of 1.170, and to contain 22.282 per cent by weight of solid matter, as follows: sodium chloride (Na Cl), 20.196 per cent; sodium sulphate ($Na_2 SO_4$), 1.834; magnesium chloride ($Mg Cl_2$), 0.252; calcium chloride ($Ca Cl_2$), a trace.

These figures are used as indicative of the present composition in several of the most recent cyclopædias, such as are used for general reference; and even the revised school text-books in geography quote as above. It should be remembered in accepting such results, however, that the investigation upon which they are based was made on water collected forty years ago; and it is scarcely to be expected that such would represent the composition of the water at the present time. For a number of years preceding 1883 the lake had been steadily rising. This rise was entirely independent of the annual oscillations to which the waters of the lake seem subject under all circumstances. In referring to this fact, Mr. Gilbert writes as follows (see "Lands of the Arid Regions," p. 66): —

"Thus it appears that in recent times the lake has overstepped a bound to which it had long been subject. Previous to the year 1865, and for a period of indefinite duration, it rose and fell with the limited oscillation and with the annual tide, but was never carried beyond a certain limiting line. In that year, or the one following, it passed the line, and it has not yet returned. The annual tide and the limited oscillations are continued as before, but the lowest stage of the new *régime* is higher than the highest stage of the old. The mean stage of the new *régime* is seven or eight feet higher than the mean stage of the old. The mean area of the water surface is a sixth part greater under the new *régime* than under the old. The last statement is based on the United States surveys of Capt. Stansbury and Mr. King. The former gathered

the material for his map in 1850, when the water was at its lowest stage, and the latter in the spring of 1869, when the water was near its highest stage. The one map shows an area of 1,750, and the other of 2,166, square miles. From these I estimate the old mean area at 1,820 miles, and the new at 2,125 miles, and the increase at 305 miles, or 17 per cent."

The probable cause of this increased water-supply in the Great Basin would form a most interesting and instructive subject of inquiry, but such would be foreign to the purposes of the present paper; and here it must suffice to say, that two theories have been advanced as offering most probable explanations of the phenomenon; viz., the climatic theory, and the theory of human agencies. In the report already referred to ("Lands of the Arid Regions") the author says, "On the whole, it may be wise to hold the question an open one, whether the water-supply has been increased by a climatic change, or by human agency. So far as we now know, neither theory is inconsistent with the facts, and it is possible that the truth includes both."

During this recent epoch of increasing volume, the lake-water would be naturally expected to show a far lower percentage of solid contents. In "Contributions to the History of Lake Bonneville," published in the "Report of the United States Geological Survey, 1880–81," Gilbert places the total salinity of the water at fifteen per cent, — a striking variation from the figures of Dr. Gale, yet a variation not at all too great to be fully explained by the increased volume of the lake, and the consequent decrease in concentration. An investigation of the water by Allen in 1869 (see King's report) showed the total solid matter to be 14.9934 per cent. The present writer made an analysis on water taken from the lake in December, 1885, with the following results: —

	Grams per Litre.	Per Cent by Weight.
Sodium chloride (Na Cl)	152.4983	13.5856
Sodium sulphate ($Na_2 SO_4$)	15.9540	1.4213
Magnesium chloride ($Mg Cl_2$)	12.6776	1.1295
Calcium sulphate ($Ca SO_4$)	1.6679	0.1477
Potassium sulphate ($K_2 SO_4$)	4.8503	0.4321
Total solid matter	187.6481	16.7162

This water had a specific gravity of 1.1225. Another sample of lake-water taken in February, 1888, showed a density of 1.1261. A further test was made in June, 1889, the water being 1.148 in density; and in August, 1889, the water was 1.1569. The figures resulting from the latest determinations show a considerable increase in the proportion of solids; and this is fully explained by the succession of excessively dry seasons to which the Great Basin has been subjected since 1883, causing a remarkable shrinking of the lake volume. In August, 1889, the lake was lower than at any time since the inauguration of Gilbert's "new *régime*." A sample of water was taken from the lake during that month, and analyzed, with these results. The water possessed a specific gravity of 1.1569, and contained, —

	Grams per Litre.	Per Cent by Weight.
Sodium chloride (Na Cl)	182.131	15.7430
Sodium sulphate ($Na_2 SO_4$)	12.150	1.0502
Magnesium chloride ($Mg Cl_2$)	23.270	2.0114
Calcium sulphate ($Ca SO_4$)	3.225	.2788
Potassium sulphate ($K_2 SO_4$)	5.487	.4742
Total solids	226.263	19.5576

It would be a difficult task indeed to determine the mean composition of the lake. Its waters rise and fall, and become more concentrated or dilute, according to the conditions controlling the rates of supply and evaporation. The latest analysis reported above, indicating 19.5576 per cent solid matter, though it is a closer approach than usual to the earliest figures, and the ones most widely published, is hardly to be considered typical, since the season of 1889 was one of unusual drought. Two or three consecutive winters with heavy snows would dilute the water to its condition of a few years ago. In the opinion of the writer, it would be more correct to quote the average contents of the Salt Lake water at sixteen per cent solid matters than at twenty-two per cent, as is most frequently done.

Our subject presents an economical aspect which is well worthy of attentive consideration. The composition of the water is such as to suggest the easy manufacture of a number of chemical substances therefrom. Branches of such an enterprise have already been instituted, and the results achieved have kindled the brightest hopes of increasing success.

The preparation of common salt from the water would be naturally the first undertaking of the kind to suggest itself; and this process has been in successful operation on an industrial scale for a number of years. There are now half a dozen establishments for salt-manufacture on the lake shore. At several of these places, however, the preparations for salt-making consist simply in constructing a number of evaporating-ponds below the level of the lake, and separated from the latter by dikes of such a height that during periods of rough water the waves beat over the embankments, and fill the ponds with brine. The evaporation of the water thus enclosed goes on without any artificial aid, and a bountiful harvest of salt in the season thereof is the result. In such cases the evaporation is carried to completion. All the solid constituents of the brine remain in the salt, there being no attempt made to get rid of the mother-liquors after the deposit of crystals.

At other of the works, however, notably at the Inland Salt Company's Gardens, a different plan is pursued. This establishment is the largest salt-works in the West, and is situated near Garfield Beach, the most popular pleasure-resort on the lake. The method employed by this company differs from those already described in that the water is pumped from the lake into ponds prepared for its reception, and situated above the level of the lake surface. The mother-liquors flow off — are returned to the lake, in fact — when the evaporation has reached the proper stage. From the establishment of the works until 1883 the lake was close to the ponds; but, owing to the unusually high rate of evaporation attending the dry seasons of the immediate past, the water has receded, so that at present it has to be conveyed over 2,500 feet to the evaporating receptacles. This is effected by the aid of two centrifugal pumps, raising together 14,000 gallons of water per minute. The pumps throw the water to a height of fourteen feet, into a flume, through which it flows to the ponds. These are nine in number, and are arranged in series. In the first pond the mechanically suspended matters are left as sediment or scum, and the water passes into the second in a clear condition. The ponds cover upwards of a thousand acres, and the drain channels leading from them aggregate nine miles in length. The pumping continues through May, June, and July. A fair idea of the rate of evaporation in the thirsty atmosphere of the Great Basin may be gained from contemplating the fact that to supply the volume of water disappearing from the ponds by evaporation requires the action of the pumps ten hours daily in June and July. This is equal to the carrying away of 8,400,000 gallons per day from the surface of the ponds.

The "salt harvest" begins in August, soon after the cessation of pumping, and continues till all is gathered, frequently extending into the spring months of the succeeding year. An average season yields a layer of salt seven inches deep, which amount would be deposited from forty-nine inches of lake-water. The density at which salt begins to deposit, as observed at the ponds, and confirmed by laboratory experiments, is 1.2121, and that of the escaping mother-liquors is 1.2345. The yield of salt is at the rate of 150 tons per inch depth per acre. The crop is gathered on horse-cars which run on movable tracks into the ponds. At the works the operations are simple and effective. A link-belt conveyor carries the coarse salt to the crusher, thence to the dryer, after which a sifting process is employed by which the salt is separated into table salt and dairy salt.

It will be seen from the foregoing that the preparation of salt

from the lake-water consists of little more than evaporation and crushing, and the former part of the operation is effected wholly through natural agencies. The simplicity of the process, and the lavish yield, enable the manufacturers to put their commodity on the market at an incredibly low price. The Inland Salt Company sells dry, coarse salt for the Eastern trade, packed on cars at the works, at one dollar per ton.

The quality of the lake-salt is of the highest grade. Several specimens of the commercial article, as manufactured and sold by the various companies, have been analyzed by the writer; and of these, the following are typical: —

	Salt made and sold by the Inland Salt Co.	Salt made and sold by the Jeremy Salt Co.
Sodium chloride (Na Cl)	98.407 per cent	98.300 per cent
Calcium chloride ($Ca Cl_2$)	.371 " "	.345 " "
Calcium sulphate ($Ca SO_4$)	.650 " "	.680 " "
Magnesium sulphate ($Mg SO_4$)	.030 " "	.042 " "
Insoluble matters	.102 " "	.472 " "
Moisture	.442 " "	.158 " "
	100.002 " "	99 997 " "

According to published figures, commercial bay salt from other sources seldom exceeds 96 per cent sodium chloride.

Next to common salt, in the order of abundance and ease of preparation, sodium sulphate should be named. This is deposited in the crystallized form as mirabilite ($Na SO_4 + 10 H_2 O$) during the winter season. When the temperature falls to a certain point, the lake-water assumes an opalescent appearance from the separation of the sulphate. This sinks as a crystalline precipitate, and much is carried by the waves upon the beach and there deposited. Under favorable circumstances, the shores become covered to a depth of several feet with crystallized mirabilite. The writer has on several occasions waded through such deposits, sinking at every step to the knees. Speaking only of the amounts thrown upon the shores, and of most ready access, the source is practically inexhaustible. The substance must be gathered, if at all, soon after the deposit first appears; as, if the water once rises above the critical temperature, the whole deposit is taken again into solution. This change is very rapid, a single day being oftentimes sufficient to effect the entire disappearance of all the deposit within reach of the waves. Warned by these circumstances, the collectors heap the substance on the shores above the lap of the waters, in which situation it is comparatively secure until needed. To a slight depth the mirabilite effloresces, but within the piles the hydrous crystalline condition is maintained. At the present time there are thousands of tons of this material, heaped in the manner described, remaining from the collections of preceding winters. The sodium sulphate thus lavishly supplied is of a fair degree of purity, as will be seen from the following analyses of two samples of the crystallized substance, taken from opposite shores of the lake: —

	1.	2.
Water ($H_2 O$)	55 070 per cent.	55.760 per cent.
Sodium sulphate ($Na_2 SO_4$)	43.060 " "	42.325 " "
Sodium chloride ($Na Cl$)	.699 " "	.631 " "
Calcium sulphate ($Ca SO_4$)	.407 " "	.267 " "
Magnesium sulphate ($Mg SO_4$)	.025 " "	.018 " "
Insoluble	.700 " "	.756 " "
	99.991 " "	99.757 " "

For purposes of easy comparison, it should be added that chemically pure mirabilite ($Na_2 SO_4 + 10 H_2 O$) consists of 44.1 per cent of sodium sulphate ($Na_2 SO_4$) and 55.9 per cent of water.

Beside such substances as are presented in a comparatively pure form by the lake, the price being simply the labor of collecting, there are many other compounds that may be had for the asking. The unlimited quantities of sodium sulphate spread upon the shore every winter, forcibly suggest the sodium-carbonate industry as a promising undertaking, the chemical labor for preparing the carbonate by the Le Blanc process being, in fact, already half done. A few years ago an establishment was founded for this purpose in Salt Lake City, and, though the labor thus far accomplished has been mostly experimental in its nature, the results conclusively prove that sodium carbonate and a number of other chemical compounds may be derived from the lake-water with ease and profit. When once such manufacture is undertaken on a proper scale, the output of soda need be limited only by the capacity of the works. Caustic soda and sodium hyposulphite have also been prepared from the lake.

The importance of the Great Salt Lake as a source of chemical supplies is still unrealized. Figures would have but little meaning if used in an attempt to express the chemical wealth diffused through its briny waters.

Even for the unscientific observer and the casual visitor, the characteristic phenomena of the lake possess a fascinating interest. Many persons who would be but slightly moved by the statement that the waters of the lake vary in density between 1.12 and 1.17 would be deeply impressed to learn that a bather can float at ease in the water with a large proportion of the body above the surface. When once accustomed to the lake, the swimmer can lie in the watery cradle, with his head resting on a pillow of wood, as securely as in a suspended hammock. The chief difficulty in swimming is the tendency of the lower limbs to rise above the water; and the principal danger lies in the occasional entrance of brine into mouth or nostrils, producing a painful irritation followed by suffocation.

The concentrated state of the brine insures the lake against the fetters of frost. Ice is not to be seen upon its bosom even during the severest winters. The temperature falls at times to —20° F., yet the lake remains as freely open as during the warmer seasons.

The antiseptic properties of the water have been known from the time of its earliest investigation. Capt. Stansbury reported a test, which has been repeatedly verified since his time. His description was as follows: —

"Before leaving Black Rock, we made an experiment upon the properties of the lake for preserving meat. A large piece of fresh beef was suspended by a cord, and immersed in the lake rather more than twelve hours, when it was found to be tolerably well corned. After this, all the beef we wished to preserve while operating upon the lake was packed into barrels, without any salt whatever, and the vessels were then filled up with the lake-water. No further care or preparation was necessary, and the meat kept sweet, although constantly exposed to the sun. I have no doubt that meat put up in this water would remain sound and good as long as if prepared by the most improved methods. Indeed, we were obliged to mix fresh water with this natural brine to prevent our meat from becoming too salt for present use, a very few days' immersion changing its character from corned beef to what the sailors call 'salt junk.'"

As would be expected of so concentrated a brine, and as has been proved by observation, life in the waters of the Great Salt Lake is confined to few species. Some writers have declared that no form of animal or plant life exists in the lake; but this is an error, with but little excuse for its perpetration. The tiny crustacean, *Artemia fertilis*, exists in very great numbers, often tinting the water over wide areas with its own delicate pink. There is also *Ephydra gracilis* in its early stages. The pupa cases of this insect are often carried ashore in large masses, where they undergo decomposition with characteristic odorous emanations. One form of *Corixa* has also been found. No fish or other large form of animal life, however, has been discovered in the waters. The vegetable organisms of the lake, the presence of which may be considered a fact from the abundance of animal existences, are almost entirely unstudied. The life of the Great Salt Lake is a subject awaiting further investigation than has thus far been bestowed thereon.

JAMES E. TALMAGE.

Salt Lake City, Utah, Dec. 11.